

1. (Currently Amended) A method of synthesizing uniform nanorods of metals, alloys, metal oxides, metal nitrides, metal pnictides phosphides, and metal chalcogenides sulfides, comprising the steps of[[;]]:

reacting a metal precursor and a first surfactant in a solvent to form a metal-first surfactant complex solution;

injecting said metal-first surfactant complex solution into a second solution containing comprising a second solvent, a second surfactant and a reagent at high temperature using a syringe pump at a constant controlled injection rate to form a reaction mixture;

reacting allowing one or more of thermal decomposition, reduction, oxidation, sulfidation or phosphidation of said reaction mixture to form said nanorods;

separating and precipitating said nanorods in the reacted mixture by adding a poor solvent; and

retrieving said nanorods by centrifuging.

2. (Currently Amended) The method of claim 1, wherein said metal precursor is selected from [[a]] the group consisting of (a) organometallic compounds including typically iron pentacarbonyl [Fe(CO)<sub>5</sub>], ferrocene, cobalt

~~tricarbonylnitrosyl [Co(CO)<sub>3</sub>(NO)]~~, ~~dicobalt octacarbonyl [CO<sub>2</sub>(CO)<sub>8</sub>]~~, ~~chromium hexacarbonyl [Cr(CO)<sub>6</sub>]~~, ~~nickel tetracarbonyl [Ni(CO)<sub>4</sub>]~~ and ~~dimanganese decacarbonyl [Mn<sub>2</sub>(CO)<sub>10</sub>]~~, (b) metal acetylacetone compounds including typically iron acetylacetone  $[Fe(acac)_3]$ , cobalt acetylacetone  $[Co(acac)_3]$ , barium acetylacetone  $[Ba(acac)_2]$ , strontium acetylacetone  $[Sr(acac)_2]$ , platinum acetylacetone  $[Pt(acac)_2]$  and palladium acetylacetone  $[Pd(acac)_2]$ , and (c) metal alkoxide compounds including typically titanium tetraisopropoxide  $[Ti(\text{OC}_3\text{H}_7)_4]$  and zirconium tetrabutoxide  $[Zr(\text{OC}_4\text{H}_9)_4]$ .

3. (Currently Amended) The method of claim 1, wherein said metals used for the metal precursors are selected from the group consisting of typically iron [Fe], cobalt [Co], nickel [Ni], chromium [Cr], manganese [Mn], barium [Ba], strontium [Sr], titanium [Ti], zirconium [Zr], platinum [Pt], palladium [Pd] and the groups II through X transition metals in particular.

4. (Currently Amended) The method of claim 1, wherein the ligands associated with said precursors are selected from the group consisting of typically carbonyl [CO], nitrosyl

[NO], cyclopentadienyl [C<sub>5</sub>H<sub>5</sub>], acetate, aromatic compounds and ~~alkoxide family alkoxides~~.

5. (Currently Amended) The method of claim 1, wherein said metal salts used as precursors are typically selected from the group consisting of iron(III) chloride [FeCl<sub>3</sub>], iron(II) chloride [FeCl<sub>2</sub>], iron(II) sulfate [FeSO<sub>4</sub>], iron(III) nitrate [Fe(NO<sub>3</sub>)<sub>3</sub>], cobalt(III) chloride [COCl<sub>3</sub>], cobalt(II) chloride [COCl<sub>2</sub>], cobalt(III) nitrate [Co(NO<sub>3</sub>)<sub>3</sub>], nickel(II) sulfate [NiSO<sub>4</sub>], nickel(II) chloride [NiCl<sub>2</sub>], nickel(II) nitrate [Ni(NO<sub>3</sub>)<sub>2</sub>], titanium tetrachloride [TiCl<sub>4</sub>], zirconium tetrachloride [ZrCl<sub>4</sub>], hydrogen hexachloroplatinate(IV) [H<sub>2</sub>PtCl<sub>6</sub>], hydrogen hexachloropalladate(IV) [H<sub>2</sub>PdCl<sub>6</sub>], barium chloride [BaCl<sub>2</sub>], barium sulfate [BaSO<sub>4</sub>], strontium chloride [SrCl<sub>2</sub>] and strontium sulfate [SrSO<sub>4</sub>], whereby these metal salts ~~consist of various are~~ metals including typically selected from the group consisting of iron [Fe], cobalt [Co], nickel [Ni], chromium [Cr], manganese [Mn], barium [Ba], strontium [Sr], titanium [Ti], zirconium [Zr], platinum [Pt], palladium [Pd], and anions including typically selected from the group consisting of chloride [Cl<sup>-</sup>], nitrate [NO<sub>3</sub><sup>-</sup>], sulfate [SO<sub>4</sub><sup>2-</sup>], phosphate [PO<sub>4</sub><sup>3-</sup>] and alkoxides.

6. (Currently Amended) The method of claim 1, wherein the metal precursors employed in the synthesis of said nanorods of alloys and multi-metallic oxides are formed using mixtures of two or more metal precursors selected from the list in claim 2 instead of using a metal precursor the group consisting of (a) organometallic compounds selected from the group consisting of iron pentacarbonyl [Fe(CO)<sub>5</sub>], ferrocene, cobalt tricarbonylnitrosyl [Co(CO)<sub>3</sub>(NO)], dicobalt octacarbonyl [CO<sub>2</sub>(CO)<sub>8</sub>], chromium hexacarbonyl [Cr(CO)<sub>6</sub>], nickel tetracarbonyl [Ni(CO)<sub>4</sub>] and dimanganese decacarbonyl [Mn<sub>2</sub>(CO)<sub>10</sub>]; (b) metal acetylacetonate compounds selected from the group consisting of iron acetylacetonate [Fe(acac)<sub>3</sub>], cobalt acetylacetonate [Co(acac)<sub>3</sub>], barium acetylacetonate [Ba(acac)<sub>2</sub>], strontium acetylacetonate [Sr(acac)<sub>2</sub>], platinum acetylacetonate [Pt(acac)<sub>2</sub>] and palladium acetylacetonate [Pd(acac)<sub>2</sub>]; and (c) metal alkoxide compounds selected from the group consisting of titanium tetraisopropoxide [Ti(<sup>1</sup>OC<sub>3</sub>H<sub>7</sub>)<sub>4</sub>] and zirconium tetrabutoxide [Zr(OC<sub>4</sub>H<sub>9</sub>)<sub>4</sub>].

7. (Currently Amended) The method of claim 1, wherein said first and second surfactant [[is]] are selected from the group consisting of (a) cationic

surfactants including typically alkyltrimethylammonium halides such as cetyltrimethylammonium bromide, (b) neutral surfactants including typically oleic acid, trioctylphosphine oxide (TOPO), triphenylphosphine (TPP), and trioctylphosphine (TOP), alkyl amines, RNH<sub>2</sub>, where R is alkyl groups with 3-18 carbons, such as oleylamine, octylamine, and hexadecylamine, and trialkylamine and alkyl thiols, and (c) anionic surfactants including typically sodium alkyl sulfates and sodium alkyl phosphates, and mixtures of two or more surfactants listed above thereof.

8. (Currently Amended) The methods method of claim 1, wherein said first and second solvent is solvents are selected from typically the group consisting of (a) ethers such as octyl ether, butyl ether, hexyl ether and decyl ether, (b) heterocyclic compounds such as pyridine and tetrahydrofurane (THF), (c) aromatic compounds such as toluene, xylene, mesitylene, benzene, (d) dimethyl sulfoxide (DMSO) and dimethylformamide (DMF), (e) alcohols such as octyl alcohol and decanol, (f) hydrocarbons such as heptane, octane, decane, dodecane, tetradecane and hexadecane, and also (g) water.

9. (Currently Amended) The method of claim 1, wherein said metal-surfactant complex solution is formed at a temperature between 20°C. and 200°C.

10. (Currently Amended) The method of claim 1, wherein the molar ratio of said metal precursor to said surfactant in the first solution is in the range between 1:0.1 and 1:100.

11. (Currently Amended) The method of claim 1, wherein for synthesizing nanorods of metal chalcogenides sulfides said reagent is selected typically from the group consisting of elemental sulfur (S<sub>8</sub>), selenium (Se), tellurium (Te), trioctylphosphine selenide (TOPSe), trioctylphosphine sulfide (TOPS) and trioctylphosphine telluride (TOPTe).

12. (Currently Amended) The method of claim 1, wherein for synthesizing nanorods of metal oxides said reagent comprises an oxidant [[is]] selected typically from the group consisting of oxygen (O<sub>2</sub>), hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>), and amine N-oxide—such as pyridine N-oxide and trimethylamine N-oxide.

13. (Currently Amended) The method of claim 1, wherein for synthesizing metal nanorods said reductant is reagent comprises a reducing agent selected typically from the group consisting of sodium borohydride ( $\text{NaBH}_4$ ), lithium aluminum hydride ( $\text{LiAlH}_4$ ), lithium triethylborohydride (super-hydride,  $\text{LiB}(\text{C}_2\text{H}_5)_3\text{H}$ ), tetramethylammonium borohydride ( $(\text{CH}_3)_4\text{NBH}_4$ ) and hydrogen gas.

14. (Currently Amended) The method of claim 1, wherein said metal-surfactant complexes are complex solution is injected into [[a]] the second solution at a temperature between 0°C. and 400°C.

15. (Currently Amended) The method of claim 1, wherein said metal-surfactant complex complex solution is injected into a solution using a syringe pump at an injection rate between 1 mL/hr and 100 mL/hr.

16. (Currently Amended) The method of claim 1, wherein said reaction process of said thermally decomposing, reducing, oxidating, sulfidating and/or phosphidating of the reaction mixture is carried out at a temperature between 0°C. and 400°C.

17. (Currently Amended) The method of claim 1, wherein said reaction process of the thermally decomposing, reducing, oxidating, sulfidating and/or phosphidating of the reaction mixture is carried out to form the nanorods is conducted for a time period of between 1 minute and 72 hours.

18. (New) The method of claim 7, wherein the cationic surfactants are alkyltrimethylammonium halides; the neutral surfactants are selected from the group consisting of oleic acid, trioctylphosphine oxide (TOPO), triphenylphosphine (YPP), trioctylphosphine (TOP), alkyl amines of the chemical formula  $RNH_2$ , wherein R is ( $C_2-C_{18}$ ) alkyl selected from oleylamine, octylamine, hexadecylamine, trialkylamine and alkyl thiols; and the anionic surfactants are selected from the group consisting of sodium alkyl sulfates and sodium alkyl phosphates.

19. (New) The method of claim 18, wherein the alkyltrimethylammonium halides comprise cetyl trimethylammonium bromide.

20. (New) The method of claim 8, wherein the ethers are selected from the group consisting of octyl ether, butyl

ether, hexyl ether and decyl ether; the heterocyclic compounds are selected from the group consisting of pyridine and tetrahydrofuran (THF); the aromatic compounds are selected from the group consisting of toluene, xylene, mesitylene, and benzene; the alcohols are selected from the group consisting of octyl alcohol and decanol; and the hydrocarbons are selected from the group consisting of heptane, octane, decane, dodecane, tetradecane and hexadecane.

21. (New) The method of claim 2, wherein the metallic compounds are selected from the group consisting of iron pentacarbonyl  $[Fe(CO)_5]$ , ferrocene, cobalt tricarbonylnitrosyl  $[Co(CO)_3(NO)]$ , dicobalt octacarbonyl  $[Co_2(CO)_8]$ , chromium hexacarbonyl  $[Cr(CO)_6]$ , nickel tetracarbonyl  $[Ni(CO)_4]$  and dimanganese decacarbonyl  $[Mn_2(CO)_{10}]$ ; the metal acetylacetone compounds are selected from the group consisting of iron acetylacetone  $[Fe(acac)_3]$ , cobalt acetylacetone  $[Co(acac)_3]$ , barium acetylacetone  $[Ba(acac)_2]$ , strontium acetylacetone  $[Sr(acac)_2]$ , platinum acetylacetone  $[Pt(acac)_2]$  and Palladium acetylacetone  $[Pd(acac)_2]$ ; and the metal alkoxides are selected from the group consisting of

titanium tetraisopropoxide  $[\text{Ti}(\text{OC}_3\text{H}_7)_4]$  and zirconium tetrabutoxide  $[\text{Zr}(\text{OC}_4\text{H}_9)_4]$ .

22. (New) The method of claim 12, wherein the oxidant is selected from the group consisting of pyridine N-oxide and trimethylamine N-oxide.